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In Reply Refer To:
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August 8, 1995

Instruction Memorandum No. DW-95-4060
Expires: 09/30/95

To: All State Directors
Attn: State GCDB Project Managers

From: Chief, Office of IRM/Modernization

Subject: Collection of Curve Data for Geographic Coordinate Data Base
(GCDB)

This memorandum issues the GCDB curve policy from the Denver Washington GCDB Project Office. This curve policy takes effect immediately.

To minimize the workload associated with implementing the curve policy, existing files will be utilized to collect the curve elements needed for ALMRS. The curve elements that will be populated on the target system for ALMRS are:

1. Curve Line Long Chord Distance Measure - a straight line connecting the beginning point of curvature and the ending point of curvature.
2. Curve Line Long Chord Distance Unit of Measure Code - the units of measure with which a curve long chord measurement is taken.
3. Curve Line Long Chord Direction Measure - the azimuth or bearing of the long chord for a curve.
4. Curve Line Long Chord Direction Quadrant Code - the quadrant of the direction when it is a bearing.
5. Curve Line Long Chord Direction Unit of Measure Code - the unit of measure for direction (example Degrees-Minutes-Seconds DdMmSs.sss)
6. Curve Line Direction of Concavity Code - the direction of concavity of a curve relative to the long chord direction.

7. Curve Line Type Code - the code that identifies the type of curve (domain values are CIR for circular curve, PAR for parabolic curve, and SPI for spiral curve).
8. Curve Line Spiral Length Measure - the nominal distance around a spiral curve segment.
9. Curve Line Spiral Length Unit of Measure - the units of measure used for the distance measurement for a spiral curve.
10. Curve Line Radius Beginning Point Distance Measure - the length of the radius at the beginning point of a curve.
11. Curve Line Radius Ending Point Distance Measure - the length of the radius at the ending point of a curve.
12. Curve Line Radius Distance Unit of Measure Code - the units of measure with which the radius, at either the beginning or ending points of an appropriate curve, is measured.

The above curve elements that are not collected by this direction will be derived during the GCDB Data Conversion process. The following direction covers methods to collect the necessary curve elements mentioned above with a minimum impact on existing State GCDB staffs. All examples in this document that refer to measurements of a curve (circular and spiral) do not represent actual values and are present only to show how the information is to be collected.

Curve Elements for PCCS or GMM Computed Townships

This directive deals with:

1. Circular curves being collected by either the Long Chord (LC), Radius (R), or a series of sub-chords along the arc of a circular curve, or
2. spiral curves.

All curves must have a distinct Source/Survey Identifier (SID) so multiple curves from the same source document can be uniquely identified for ALMRS. (See the examples for collecting curve elements in the RAW file.)

Tangent Curves

A tangent curve is defined as: an arc that is tangent to two line segments, the beginning of the curve (BC), more commonly known as the point of curvature, and the end of the curve (EC), more commonly known as the point of tangency.

For the Long Chord (LC) identified in the RAW DATA file, add an extension to the distinct SID for the curve in the following manner:

/TCnnLC, where TC represents a Tangent Curve and nn is the number of the curve identified in the RAW DATA file, (should start with 1 and increment by 1, for a maximum of 99, for each new tangent curve encountered within a township) and LC is the curve element.

The LC of the Tangent Curve must be connected in the RAW DATA file to the line segments leading into the BC and out of the EC.

Example of a tangent curve collected in the RAW DATA file.

837010	837020	4.750	3	283145.0	100049	(Line segment into BC)
837020	837030	2.530	2	614815.0	100049/TC01LC	(Long Chord)
837030	837040	4.150	3	264145.0	100049	(Line segment from EC)
837040	837050	6.760	4	632945.0	100049	

GCDB State Offices must collect curve elements 1, 3, and 4. Curve elements 2, 5, 6, 7, 10, 11, and 12, along with the element Line Geometry Type Code, will be derived during data conversion.

Nontangent Curve

A nontangent Curve is defined as a curve that is not tangent at the BC and/or EC. For nontangent curves with the LC identified in the RAW DATA file, add an extension to the distinct SID for the curve in the following manner:

/CnnLC, where C represents a nontangent circular curve and nn is the number of the curve identified in the RAW DATA file, (should start with 1 and increment by 1, for a maximum of 99, for each new circular curve encountered within a township) and LC is the curve element.

Additional elements must be added to collect enough curve information for ALMRS. Immediately following the LC line segment in the RAW DATA file add the line segment depicting the radius line from the BC to the Radius Point (RP).

/R, where R is the radius line segment from the BC to the RP.

GCDB State Offices must collect curve elements 1, 3, 4, 10, and 11. Curve elements 2, 5, 6, 7, and 12 along with the element Line Geometry Type Code will be derived during data conversion.

Example of a nontangent circular curve collected in the RAW data file.

837010	837020	4.750	3	283145.0	100049	(Line segment into BC)
837020	837030	2.530	2	614815.0	100049/C01LC	(Long Chord)
837020	837025	4.500	1	612815.0	100049/R	(Radius from BC to RP)
837030	837040	4.150	3	264145.0	100049	(Line segment from EC)

Note: Colorado collected curves through the RP, and therefore only needs to add the LC to the data conversion input RAW file.

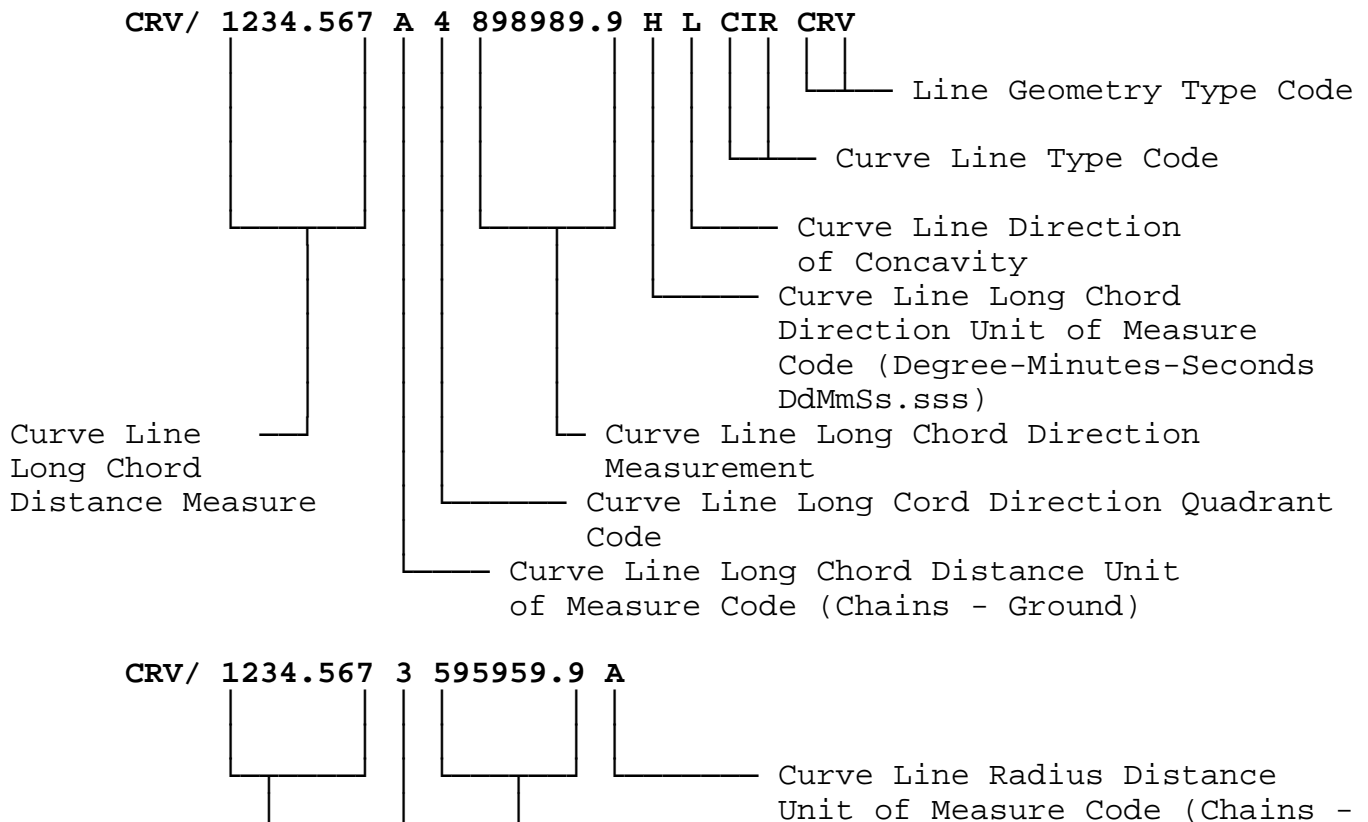
Moving of circular curve elements during Data Conversion from the RAW file to the SID file.

The curve elements (collected and derived) will be located in the SID file as shown in the example below. This will include the original line segments of the curve used for computations and the line segments added to collect additional curve elements. This process will occur during the data conversion process.

Example of circular curve elements collected in the .SID file:

```
S100049/C01      0.100 30000.0 10800.0  25.000  25.000
C/* (retained comments from original .SID file)
C/** (structured comments from original .SID file)
CRV/ 1234.567 A 4 898989.9 H L CIR CRV
CRV/ 1234.567 3 595959.9 A
CRV/ 837020 837030 837025
```

Breakdown of the circular curve element definitions in the .SID file:



Curve Line ———— Ground)
 Radius Beginning ———— Bearing of the Radius from the BC to the
 Point Distance ———— RP
 Measure ———— Quadrant of Radius from the BC to the RP

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CRV/ 837020 837030 837025
 Beginning of ————
 Curve Point ID ————
 End of Curve ————
 Point ID ———— Radius Point ID (Colorado Only)

Example of a circular curve (tangent and nontangent) in the TOWNSHIP.RAW file after conversion:

837010	837020	4.750	3	283145.0	100049	(Line segment into BC)
837020	837030	2.530	2	614815.0	100049/C01LC	(Long Chord)
837030	837040	4.150	3	264145.0	100049	(Line segment from EC)
837040	837050	6.760	4	632945.0	100049	

Example of a Colorado circular curve in the TOWNSHIP.RAW file after conversion:

837010	837020	4.750	3	283145.0	100049	(Line segment into BC)
837020	837030	2.530	2	614815.0	100049/C01R	(Radius from BC to RP)
837030	837035	4.500	1	612815.0	100049/C01R	(Radius from RP to EC)
837035	837040	4.150	3	264145.0	100049	(Line segment from EC)
837040	837050	6.760	4	632945.0	100049	

Curves portrayed by subchords along the arc of the curve.

A curve portrayed by subchords is defined as: a curve that has two or more subchords. No restriction is placed on the number or length of the subchords. Subchords must be identified in the RAW DATA file with an extension to the SID in the following manner:

/Vnn, where V identifies the line segment as a sub-chord, and nn represents the number, (start with 1 and increment by 1, for a maximum of 99, for each new sub-chord within the RAW DATA file).

Curves portrayed by subchords must have the following line segments added to the RAW DATA file: the LC as the record immediately preceding the subchords and the radius from the BC to the RP as the record immediately following the subchords. The LC and Radius must have the SID extension as defined previously for a nontangent curve.

GCDB State Offices must collect curve elements 1, 3, 4, 10, and 11. Curve elements 2, 5, 6, 7, and 12 along with the element Line Geometry

Type Code will be derived during data conversion.

Example of subchords collected in the RAW DATA file before conversion:

RP)	837010	837020	4.750	3	283145.0	100049	(Line segment into BC)
	837020	837030	2.530	2	614815.0	100049/C01LC	(Long Chord)
	837020	837021	0.500	2	333333.0	100049/V01	(Subchord 1)
	837021	837022	0.500	2	433333.0	100049/V02	(Subchord 2)
	837022	837030	1.540	2	533333.0	100049/V03	(Subchord 3)
	837020	837025	4.500	1	612815.0	100049/R	(Radius from the BC to the
	837030	837040	4.150	3	264145.0	100049	(Line segment from EC)
	837040	837050	6.760	4	632945.0	100049	

Example of curve elements in the .SID file for curves collected by subchords:

```
S100049/C01      0.100 30000.0 10800.0    25.000    25.000
C/* (retained comments from original .SID file)
C/** (structured comments from original .SID file)
CRV/ 1234.567 A 4 898989.9 H L CIR CRV
CRV/ 1234.567 3 595959.9 A
CRV/ 837020 837030 837025
```

Breakdown of the curve element definitions in the .SID file for curves collected by subchords:

The diagram illustrates the structure of the Curve Line Long Chord Distance Unit of Measure Code (CRV/1234.567 A 4 898989.9 H L CIR CRV). The code is divided into several fields, each with a specific description:

- CRV/**: Curve Line Long Chord Distance Measure
- 1234.567**: Curve Line Long Chord Distance Unit of Measure Code (Chains - Ground)
- A**: Curve Line Long Chord Direction Quadrant Code
- 4**: Curve Line Long Chord Direction
- 898989.9**: Curve Line Long Chord Distance Measurement
- H**: Curve Line Long Chord Direction of Concavity
- L**: Curve Line Long Chord Direction of Concavity
- CIR**: Curve Line Type Code
- CRV**: Line Geometry Type Code

CRV/ 1234.567 3 595959.9 A

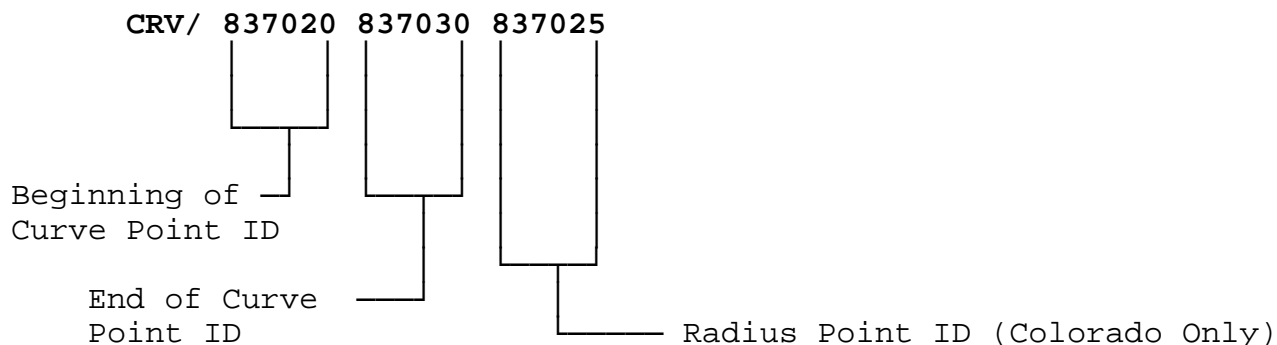
Curve Line Radius Distance
Unit of Measure Code (Chains -
Ground)

Curve Line Bearing of the Radius from the BC to the

Radius Beginning
Point Distance
Measure

RP
Quadrant of Radius from the BC to the RP

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Example of subchords collected in the RAW DATA file after conversion:

837010	837020	4.750	3	283145.0	100049	(Line segment into BC)
837020	837021	0.500	2	333333.0	100049/V01	(Subchord 1)
837021	837022	0.500	2	433333.0	100049/V02	(Subchord 2)
837022	837030	1.540	2	533333.0	100049/V03	(Subchord 3)
837030	837040	4.150	3	264145.0	100049	(Line segment from EC)
837040	837050	6.760	4	632945.0	100049	

Spiral Curves

Spiral curves should be identified in the RAW DATA file with an extension to the SID in the following manner:

/SnnLC, where S represents Spiral curve and nn is the number of the spiral curve identified in the RAW DATA file (should start with 1 and increment by 1 to a maximum of 99 for each new spiral curve encountered within a township) and LC is the chord (distance from the beginning to the end of the spiral curve).

/SnnR#, where Snn matches the same value from the chord, and R is the radius line segment and # is equal to:

1. When the radius of the spiral to curve occurs at the beginning of the spiral curve.
2. When the radius of the spiral to curve occurs at the end of the spiral curve.

Note: for a spiral curve the spiral to curve radius is a known value while the tangent to spiral radius has an infinite value. The value of 1 and 2 above is intended to portray the radius of the spiral to curve. This will depend on the direction of the traverse and if the spiral to curve radius is at the beginning or end of the spiral curve.

Example of a spiral curve collected in the RAW file:

836090	837000	4.750	3	283145.0	100049	(Line Segment into Spiral)
837000	837010	0.500	4	452619.0	100049/S01LC	(Spiral Curve Chord)
837010	837015	4.500	1	612815.0	100049/S01R2	(Spiral to Curve Radius)
837000	837010	0.650	0	0.0	100049/S01LS	(Length of Spiral)
837010	837020	2.530	2	614815.0	100049/C01LC	(Circular Curve Long
Chord)						
837010	837015	4.500	1	612815.0	100049/R	(Circular Curve Radius)
837020	837030	0.500	3	001515.0	100049/S02LC	(Spiral Curve Chord)
837020	837025	4.500	2	351515.0	100049/S02R1	(Spiral to Curve Radius)
837020	837030	0.650	0	0.0	100049/S02LS	(Length of Spiral)
837040	837050	4.150	3	264145.0	100049	(Line Segment from Spiral)
837050	837060	6.760	4	632945.0	100049	

Example of spiral curve elements added to the .SID file.:

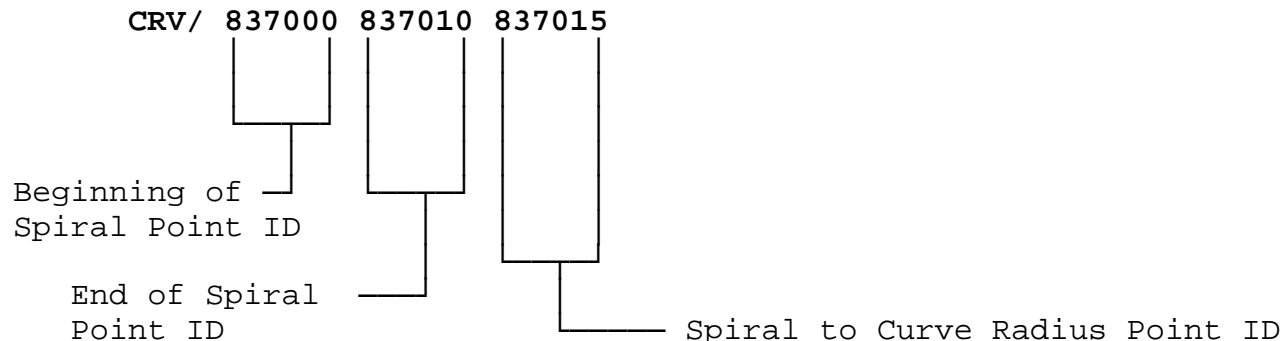
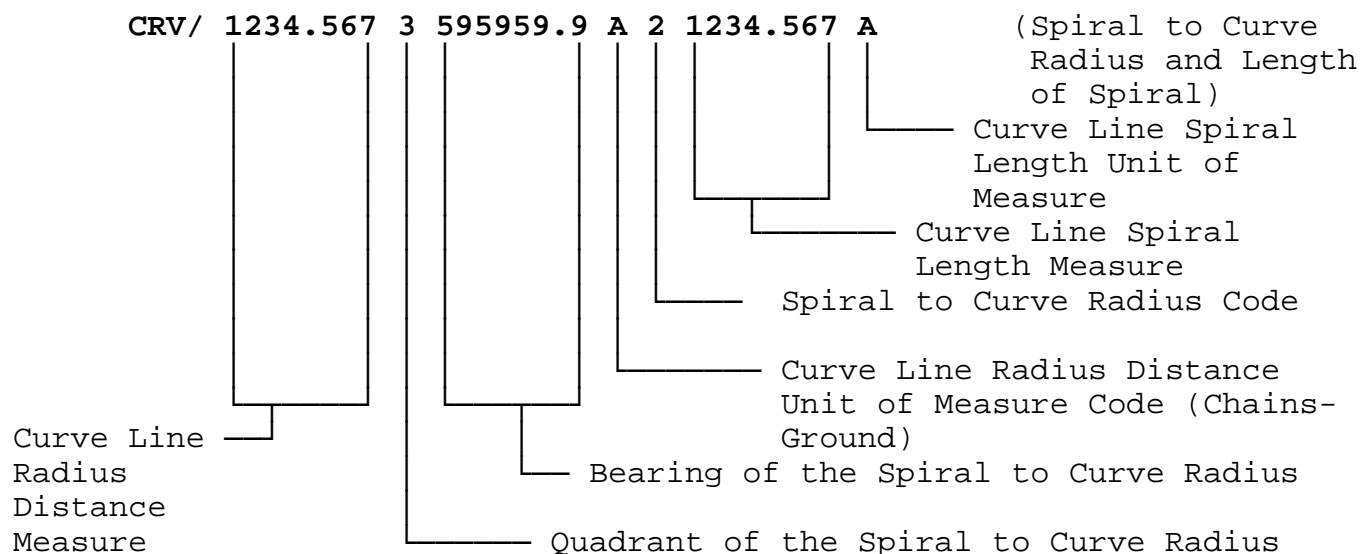
```

S100049/S01      0.100 30000.0 10800.0   25.000   25.000
C/* (retained comments from original .SID file)
C/** (structured comments from original .SID file)
CRV/ 1234.567 A 4 898989.9 H L SPI CRV
CRV/ 1234.567 3 595959.9 A 2 1234.567 A
CRV/ 837000 837010 837015

```

Breakdown of the spiral curve element definitions in .SID file:

CRV/	1234.567	A	4	898989.9	H	L	SPI	CRV	(Long Chord - Curve
									Elements Line 1)
									Line Geometry Type Code
									Curve Line Type Code
									Curve Line Direction of
									Concavity
									Curve Line Long Chord
									Direction Unit of Measure
									Code (Degree-Minutes-
									Seconds DdMmSs.sss)
Curve Line									Curve Line Long Chord Direction
Long Chord									Measurement
Distance Measure									Curve Line Long Chord Direction Quadrant
									Code
									Curve Line Long Chord Distance Unit of
									Measure Code (Chains - Ground)



Example of a spiral curve in the RAW file after conversion.

836090	837000	4.750	3	283145.0	100049	(Line Segment into Spiral)
837000	837010	0.500	4	452619.0	100049/S01LC	(Spiral Curve Chord)
837010	837020	2.530	2	614815.0	100049/C01LC	(Circular Curve Long
Chord)						
837020	837030	0.500	3	001515.0	100049/S02LC	(Spiral Curve Chord)
837030	837040	4.150	3	264145.0	100049	(Line Segment from Spiral)
837040	837050	6.760	4	632945.0	100049	

If there are any questions concerning the collection of curve elements, please contact Tim Woods at (303) 236-3888.

/s/ Monte G. Jordan

Distribution

WO-106, LS, Rm 401
 WO-890 (Y. Kinney), LS, Rm 775
 TC-100, Manager
 SC-653, Library
 DW-110, Central Files

113:JWoods:bg:x8915:8-4-95:CURVE.11